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Ms. Magalie Roman Salas
Office of the Secretary
Federal Communications Commission
445 12th Street, SW, TW-A325
Washington, DC 20554

Re: Reallocation of the 216-220 MHz, 1390-1395 MHz, 1427-1429 MHz, 1429-1432 MHz, 1432-1435 MHz, 1670-1675 MHz, and 2385-2390 MHz Government Transfer Bands -- ET Docket No. 00-221, RM- 9267, RM-9692, RM-9797, RM-9854

Dear Ms. Salas:

Transmitted herewith, on behalf of Trimble Navigation Limited, are an original and 12 paper copies and one diskette "read only" copy of Trimble's comments in the above-referenced rule making proceeding. A diskette "read only" copy of these comments has also been sent to the Commission's copy contractor, ITS, Inc.

Please date stamp the enclosed "Return" paper copy and return it to the courier delivering this package.

Should you have any questions, please contact the undersigned.

Respectfully submitted,

Raul R. Rodriguez

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Enclosures

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BEFORE THE

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of	)	
	)	
Reallocation of the 216-220 MHz,	)	ET Docket No. 00-221
1390-1395 MHz, 1427-1429 MHz,	)	RM-9267
1429-1432 MHz, 1432-1435 MHz,	)	RM-9692
1670-1675 MHz, and 2385-2390 MHz	)	RM-9797
Government Transfer Bands	)	RM-9854

COMMENTS OF TRIMBLE NAVIGATION LIMITED

Trimble Navigation Limited ("Trimble"), by its attorneys and pursuant to Sections 1.415 and 1.419 of the Commission's rules, 47 C.F.R. §§ 1.415 and 1.419, hereby comments on the above-captioned rulemaking proceeding concerning the allocation of 27 MHz of spectrum to be transferred from government to non-government use.[1] These comments address only the Commission's proposals for, and the issues relating to, the 216-220 MHz band of this spectrum. Trimble understands that the Association of Public-Safety Communications Officials-International, Inc. ("APCO"), on behalf of its user community, and Pacific Crest Corporation ("Pacific Crest") have identified spectrum within this band for possible use in land survey operations, and it is the intent of these comments to support those efforts. More specifically, Trimble requests that the Commission allocate portions of the 216-217 MHz band for use in connection with Real-Time Kinematic ("RTK") systems, a highly accurate surveying technology that provides critical public safety services using the satellites of the U.S. Global Positioning System ("GPS"). As explained more fully below, Trimble believes that allocation of the 216-217 MHz band for RTK GPS will alleviate the acute shortage of spectrum for this important service without interfering with existing

1 Reallocation of the 216-220 MHz, 1390-1395 MHz, 1427-1429 MHz, 1429-1432 MHz, 1432-1435 MHz, 1670-1675 MHz, and 2385-2390 MHz Government Transfer Bands, Notice of Proposed Rule Making, FCC 00-395 (Nov. 20, 2000) ("NPRM").

operations in that band. Trimble also supports APCO's request that RTK GPS service be designated as exempt from auction under the public safety service exemption to the Commission's competitive bidding rules.

I. Introduction and a Brief Description of RTK GPS.

Trimble, a U.S. corporation, is a leader in the development of technology-based products that employ the GPS, a constellation of satellites operated by the U.S. Government that provide position and time information to users worldwide. Signals transmitted from the GPS satellites to terrestrial, aeronautical or maritime receivers enable users to determine the unique address of any point on Earth or to "time tag" any event. When these signals are combined with communications devices and computers, such as map-based applications of the Geographic Information Systems, a broad range of applications, including surveying, automobile navigation, asset management and telecommunications infrastructure, are possible with a degree of accuracy and speed unavailable from any comparable technology.

Varying degrees of accuracy are possible depending on the type of GPS receiver employed. The most basic GPS receiver can make measurements to within several feet using only the GPS satellites as reference points. More accurate GPS receivers employ stationary reference stations and itinerant mobile receivers, or "rovers," to allow users to eliminate the bias errors in the GPS signals from the satellites they are using. The most accurate receivers employ RTK GPS (or "precision GPS") technology, a surveying technique that takes measurements at a fixed reference station and transmit them via a wireless data link to a rover that uses these measurements, together

with its own measurements, to compute the position of the mobile receiver to an accuracy of one to two centimeters.[2]

The highly accurate positional and temporal measurements that precision GPS systems make possible are increasingly relied upon by both public and private entities – particularly in connection with public safety applications. Today, there are more than 50,000 "dual frequency" (i.e., RTK GPS) equipment users worldwide, with approximately 30,000 of these users making up the domestic U.S. market. Approximately forty percent of the domestic U.S. market is comprised of federal, state, county and city governmental agency users. These public entities employ RTK GPS systems for applications with broad public safety implications, including disaster management and recovery operations, police, fire and medical emergency response, and infrastructure construction and maintenance. Specific examples of the types of critical public safety services made possible through governmental use of RTK GPS include the following:

- The collection of data to assess damage in the aftermath of natural disasters, such as Hurricane Andrew in Florida, the Oakland Hills and Fountain fires in California's Sierra Nevada Mountains, and the Northridge, California earthquake.
- The development by the California Department of Transportation of a routing system for snowplows during winter storm emergencies.
- The planning, design, construction, and maintenance of flood control and drainage facilities in many parts of the Western United States.
- The precise mapping of hazardous waste sites, such as the Rocky Flats nuclear weapons plant.

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2 For a more thorough description of GPS operations, see Global Positioning System: Market Projections and Trends in the Newest Global Information Technology," International Trade Administration, Office of Telecommunications, U.S. Department of Commerce (1998) at 7-11 ("Commerce Department Report").

Non-governmental entities also rely on RTK GPS for the provision of public safety services, including:

- The guidance and control of earth-moving and cutting machines by the construction industry to avoid cutting buried pipelines or utility conduits and the devastating public hazards that follow such accidents.
- The stakeout of geophysical sources and receivers by oil and gas explorers and the research and exploration of offshore drilling.
- The precise positioning of extraction equipment to increase mining safety.[3]

As these examples make clear, the emergence of precision GPS has enabled public and private entities to respond to (or to avert in the first instance) a public disaster or crisis more effectively than before. Indeed, precision GPS technology has become such a commonplace and integral tool for the provision of public safety services that the U.S. Department of Commerce has described the service as "a *pervasive* information utility in numerous public safety applications."[4]

II. The Increasingly Scarce Spectrum Available for Private RTK GPS Operations, and the Lack of Any Spectrum Available for Public RTK GPS Operations, Warrant an Additional Allocation of Spectrum.

As the public safety applications employing RTK GPS have increased, so too has demand for the scarce amount of spectrum allocated to it. RTK GPS operations are currently limited to a secondary and non-interfering basis to voice uses at 450 – 470 MHz. Government allocations in this band, however, are essentially exhausted due to the small number of channels

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3 For a more complete list of public safety services provided by RTK GPS applications, see Commerce Department Report at 13-18, attached hereto as Attachment A. The text shaded in gray in Attachment A describes RTK GPS applications.

4 Id. at 25 (emphasis added).

available for government use and growing level of demand, essentially for public safety – a demand that is predicted by the U.S. government to increase.[5] Complicating the problem of RTK GPS spectrum scarcity is the fact that governmental operations are not permitted, under Part 90 of the Commission's rules, to hold Business/Industrial Pool licenses at 450-470 MHz, which has left an estimated 70 percent of state and local government users unable to access precision GPS spectrum. Those state and local entities that have obtained access to spectrum for RTK GPS operations have done so by forming partnerships with private sector entities to plan and coordinate local public safety efforts – a process that has only resulted in further congestion of Business/Industrial Pool licenses at 450-470 MHz.

III. The 216-217 MHz Band Will Permit Spectrum-Efficient RTK GPS Operations Without Interference to Incumbent Operations.

To alleviate the shortage of spectrum available for precision GPS, the Commission should allocate a portion of the 216-217 MHz band for RTK GPS public safety services.[6] Trimble believes that RTK GPS operations in this segment of the band can be conducted in a spectrum-efficient manner that will not disrupt or limit the operations of primary or secondary incumbent licensees.[7]

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5 See id. at 37.

6 Based on a study conducted by Comsearch, Trimble concludes that an allocation for RTK GPS operations in the 217-220 MHz segment of the band is less desirable than a 216-217 MHz allocation because of primary allocations in those segments to the Automated Maritime Telecommunication System ("AMTS") or Interactive Video and Data Services ("IVDS"). See Spectrum Usage Report, Frequency Band: 216-220 MHz, Comsearch (Feb. 23, 2001), attached hereto as Attachment B.

7 Trimble urges the Commission to reject the request of Regionet Wireless License, LLC to reallocate the 218-219 MHz band to the Paging and Radiotelephone service and pair the 218-219 MHz band with the 216-217 MHz band to allow two-way paging and response. See Regionet, Petition for Rule Making, RM-9692 (filed Apr. 22, 1998). The critical public safety services made possible by RTK GPS operations – e.g., emergency response dispatch, flood control, and natural disaster assessment, among many others – would provide far greater public interest benefits than those derived from additional two-way paging services. In addition, as discussed herein, Trimble's proposed operations can

The 216-220 MHz band is allocated on a primary basis to the Maritime Mobile Service, and is also available on a secondary basis to the government radiolocation service, the government and non-government fixed service, the Aeronautical Mobile Service ("AMS"), the Land Mobile Service, and the Low Power Radio Service ("LPRS").[8] In the NPRM, the Commission noted that given the "significant constraints on additional use of the 216-220 MHz band, it is unclear how this band might accommodate additional services and how we might further assign licenses in this spectrum."[9] Although the Commission's concerns are well considered, Trimble believes that the proposed RTK GPS operations can accommodate incumbent operations at 216-217 MHz without any significant adverse effect.

As an initial matter, the primary allocation of AMTS in this segment of the band is currently not assignable and, thus, not at risk for interference.[10] Interference into the operations of the Navy's primary space surveillance ("SPASUR") radar system operation will be avoided because RTK GPS operations at 216-217 MHz can be removed from the specific bands where SPASUR operates. RTK GPS operations will not affect the secondary operations of LPRS, which the Commission singled out in the NPRM as serving important public needs,[11] because RTK GPS employs carrier sense multiple access to avoid transmitting on an occupied channel. Finally, Trimble is aware of the restriction on out of band emissions into TV Channel 13 and acknowledges

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accommodate incumbent uses in the spectrum, consistent with the Commission's spectrum management goals. See NPRM at 4.

8 See NPRM at 5. The 218-219 MHz segment of the band is also allocated on a primary basis to IVDS and on a secondary basis to the Amateur Radio Service. Id. In addition, operations in the 216-220 MHz band are constrained by the need to protect TV channel 13, which occupies the subjacent 210-216 MHz band. Id.

9 Id. at 7.

10 47 C.F.R. § 80.385 n. 2.

11 See NPRM at 6.

that it will take whatever steps are necessary, including but not limited to operating on a secondary basis, to limit such emissions.

RTK GPS operations employ a variety of techniques to achieve spectrum efficiency, including advanced modulation techniques (i.e., high bits per second per Hertz) and the transmission of data in a highly compressed format to reduce on-air time. Should RTK GPS operations result in harmful interference, the source of the offending signal can readily be identified because periodic Morse Code station identifiers are transmitted automatically. In addition, a polite transmission mode is used to inhibit the transmission whenever a received signal is detected above a set threshold. The efficacy of these and other spectrum efficiency steps has been proven by "friendly" RTK GPS operations at 450-470 MHz.

IV. RTK GPS Requires Only a Modest Amount of Channels and Bandwidth Within the 216-217 MHz Band.

The number of channels and the size of their bandwidth necessary for reliable RTK GPS operations are dictated by the type of operation at issue. For itinerant RTK GPS survey operations, Trimble recommends that 12 12.5 kHz channels and six 25.0 kHz channels be allocated. Survey operations involving a stationary reference station for a set number of days would require 25 watts ERP and an antenna height of less than 6.1 meters. For these operations, channel spacing of 12.5 kHz is adequate, as data rates of at least 4.8 kpbs are required for 1 Hz update rates used in this application. For surveying operations involving, for example, the control of the blade of a snowplow, higher RTK GPS update rates would be required. This type of application uses data rates of at least 14.4 kbps and channel spacing of 25 kHz is required.[12]

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12 Trimble notes that some Global Navigation Satellite Services applications also require 25 kHz channels.

Operations involving a RTK GPS station at a permanent site for surveying purposes would, with frequency coordination, require eight 12.5 kHz channels. The power and height requirements for these operations would be the same as those applied to 150-174 MHz operations by Section 90.205 of the Commission's rules.[13]

V. RTK GPS Is a Public Safety Service That Should Be Exempt From Competitive Bidding.

The licensing of RTK systems in the 216-217 MHz band, as proposed herein, should be conducted without competitive bidding pursuant to the statutory public safety service exemption. Although the Commission concluded in the NPRM that licenses in the 216-220 MHz band must be awarded by auction in accordance with Section 309(j) of the Communications Act of 1934, as amended,[14] it also sought comment on whether specific services should be exempted from auction as public safety radio services.[15] The Commission has described the scope of the public safety exemption as not limited to "traditional" public safety services (e.g., police or fire departments) and that non-commercial services provided by utilities, railroads and transit systems could also be deemed eligible for the exemption as "non-traditional" public safety services.[16] The Commission has also concluded that all state and local government entities are eligible for licensing in the public safety radio services without any further showing as to eligibility.[17] Trimble

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13 47 C.F.R. § 90.205.

14 See NPRM at 6.

15 See id. at 4-5. The Balanced Budget Act of 1997 amended Section 309(j) to restrict the Commission's authority to auction licenses and permits for public safety radio services and certain broadcasters. See Pub. L. 105-33, 111 Stat. 251 (1997) (codified at 47 U.S.C. § 309(j)(A)(2)). See also NPRM at 3.

16 See Implementation of Sections 309(j) and 337 of the Communications Act of 1934, as Amended, FCC 00-403, slip op. (Nov. 20, 2000) at 32.

17 See id. at 35.

emphasizes that the majority of RTK GPS applications are conducted by governmental agencies or private agencies under contract on behalf of governmental agencies, and believes that the nature of the RTK GPS service falls squarely within the types of traditional and non-traditional public safety services envisioned by the Commission to be auction-exempt.

Under the two-part test adopted by the Commission, a non-traditional public safety service may be assigned a license without auction if the dominant use of the service is by entities that (1) have an infrastructure that they use primarily for the purpose of providing essential public services to the public at large; and (2) need, as part of their regular mission, reliable and available communications in order to prevent or respond to a disaster or crisis affecting the public at large.[18] The RTK GPS service qualifies under this two-part standard because the dominant use of the technology by public and private users involves fixed physical facilities serving the public (e.g., roads, bridges, utility conduits, or hazardous waste sites) where a breakdown in the system creates a dangerous condition that would adversely affect the public at large (e.g., an imprecise calculation leading to an improperly constructed bridge). Indeed, the Commission could well have been describing the RTK GPS service itself when it explained that non-traditional entities provide public safety services if "the nature of their day-to-day operations provide little or no margin for error" and where "[a]ny failure in their ability to communicate by radio could have severe consequences on the public welfare."[19] In light of the important public safety applications of the RTK GPS service, the Commission should exempt the service from auctions when assigning licenses.

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18 See id. at 39. The Commission has described an "infrastructure" for purposes of this two-part standard as "fixed physical facilities that extend beyond the licensee's place of business to areas where the public at large live and work and are therefore exposed to adverse results stemming from a breakdown in the licensee's infrastructure." Id.

19 Id. at 38.

CONCLUSION

For the foregoing reasons, Trimble supports the efforts of the APCO user community and Pacific Crest to gain access to spectrum for RTK GPS operations. Trimble, therefore, requests that the Commission alleviate the shortage of spectrum set aside for RTK GPS by allocating portions of the 216-217 MHz band for that service, and to assign licenses to that band without auction under the public safety exemption.

Respectfully submitted,

TRIMBLE NAVIGATION LIMITED

By: _____

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ATTACHMENT A

Excerpt from:

Global Positioning System: Market Projections and Trends in the Newest Global Information Technology

International Trade Administration
Office of Telecommunications
U.S. Department of Commerce
1998

The shaded text describes RTK GPS applications.

Potential Civil, Commercial and Consumer use for GPS in communication

ENVIRONMENTAL PROTECTION

• Ground mapping of ecosystems
GPS is used to map all manner of ecosystems, from eel grasses in the Puget Sound to coastlines in Louisiana.

• Overviews of environmental phenomena
Comprehensive views of deforestation, as well as environmental phenomena in lake, rivers and estuaries, are analyzed and through overviews of a variety of spatial features that are referenced to GPS-derived coordinates.

• Preventing ground water pollution
GPS is used to perform exact location inventories of wells and potential contamination sources and map the migration of toxic plumes in ground water.

• Monitoring health of the food chain
If microscopic plankton die, marine life higher on the food chain also perish. GPS is used to collect scientific samples for studies on the effects of ultraviolet radiation and other hazards on bacterioplankton.

• Air pollution measurement
GPS receivers were coupled with gas sensors to map positions of air pollution concentrations to correlate satellite data with ground-based samples.

• Mapping of sub-surface contamination
GPS was used to map pollutants in Arctic ice. Results showed that even in the remote arctic, industrial chemicals have penetrated into the ecosystem.

• River management to avert natural disasters
In Paraguay, GPS is used to detect natural canals and precisely determine the height of new channels to facilitate correct sediment deposit, and thereby controlling water flow and preventing floods.

• Flood control facilities
GPS is used to plan, design, construct, and maintain needed flood control and drainage facilities and to protect and increase the quantity and quality of groundwater in many parts of the Western United States.

• Oil spill tracking and cleanup
The National Oceanic and Atmospheric Administration (NOAA) uses GPS affixed to buoys to track the movement of oil spills and monitor how fast a spill is spreading. This information helps to manage the work of emergency crews more efficiently.

• Management and maintenance of roads
Using GPS, Italian companies have developed a system of computers and imaging equipment to gather information about road networks with inventories of features and attributes required for administration and maintenance.

• Hazardous waste site investigation
With the protective gear necessary at a hazardous waste site, it is difficult to use conventional surveying techniques. GPS is often used to perform real-time surveys using digital terrain modeling at sites heavily contaminated with asbestos, lead dust, PCBs and other hazardous materials.
• Precise location of stored hazardous materials
GPS is used in Department of Energy efforts to stabilize nuclear wastes from the Rocky Flats nuclear weapons plant, which operated from 1950 to 1980. Surveyors and engineers used GPS to precisely map the locations of hazardous waste sites.

• Time-tagging of hazardous materials spills or other incidents.

• Time-tagging of dredge dumping operations
GPS was used on drainage barges to tag location and time of dumping to ensure adherence to Environmental Protection Agency (EPA) regulations and public safety concerns.

• Monitoring of natural gas and oil pipelines
A German firm has used GPS to develop intelligent pipe corrosion detection tools. GPS provide extremely precise information on defect locations so that operators can quickly repair dangerous flaws and problems. Potential Civil, Commercial and Consumer use for GPS in environmental protection

FORESTRY AND AGRICULTURE

• Forest area and timber estimates
GPS is used to map timber block cut areas to avoid costly traditional surveying and to verify instances of intentional over-harvesting.

• Protecting endangered species
GPS is used to map endangered species habitats and track migratory patterns.

• Instant mapping of fire perimeters
GPS mapping receivers are used in helicopters to fly the perimeter of fires for dynamic mapping, which allows more efficient use of firefighting resources, as well as saving forests and homes.

• Forest fire tracking and containment
Using GPS and weather service maps, fire fighting aircraft are able to investigate lightning strikes to see if a forest fire has been started. If a fire is found, the pilot records the location and then brings the data back so that fire containment operations can go right to the fire location.

• Precise plowing, planting, fertilizing and other farm uses
GPS data is collected in the field to control weeds and disease, as well as mapping field boundaries, roads and irrigation systems. Variable rate application of fertilizer in orchards and vineyards can be done in combination with GPS mapping. Minimizing application of fertilizer prevents ground water runoff into streams.

• Unmanned (robotic) harvesting and plowing
At Stanford University, graduate students are working on an experimental autopiloted tractor that could work in any weather, 24-hours a day.

• Precision crop dusting by aircraft
In Chile, crop dusters can spray pesticides on banana plantations without using row-end human flaggers to guide pilots. Instead, GPS guides the pilot showing when the end of a field or area has been reached. Workers avoid exposure to highly toxic agricultural chemicals. In California, GPS is used to help pilots control aerial application of pesticides and other chemicals on crops and minimize the spray drift of chemicals.

Potential Civil, Commercial and Consumer use for GPS in forestry and agriculture

GROUND TRANSPORTATION

• Intelligent Transportation System - ITS
In Albuquerque, New Mexico, the Transit Department used GPS to build an integrated ITS architecture that includes GPS Automatic Vehicle Location (AVL) systems, wireline and wireless communications and Geographic Information Systems (GIS) data. This intelligent transportation architecture provides tracking, monitoring and scheduling systems for fixed route buses, vans, and paratransit vehicles in the city.

• In-vehicle wireless voice systems
The Queensland, Australia train system uses an automated GPS-based system to announce stops to onboard passengers and provide train locations to waiting passengers.

• Truck fleet on-the-road management
More than 225,000 trucks worldwide are scheduled, tracked and monitored using satellite-based communications and GPS. These systems improve service and fleet communications. A Dutch trucking company uses GPS-based automatic vehicle location system to schedule and track trucks delivering perishable produce to market before it spoils. In the United States and Mexico, cement suppliers use GPS and fleet management software to more efficiently route cement trucks to work sites. This enables more efficient use of the trucks and improves service over a wider area.

• Courier dispatch services and vehicle location
A courier service streamlined its response time for customers by knowing where every delivery vehicle is at any time.

• Cargo fleet tracking and security
Truck fleets use GPS to achieve efficient routing and scheduling. In addition, trucks carrying dangerous or high-value cargo can be tracked to protect against hijacking.

• Commercial vehicle fleet communications and tracking
Vehicle fleet operations use GPS-based automatic vehicle systems to track everything from taxis to tow trucks. In Australia, GPS units include an emergency response system that protects driver safety. Pushing the button sends a location stamped message to dispatchers who can contact police with the exact location of the incident.

• Improved public services, including taxi and public transportation systems

In Singapore, callers to a taxi service use a system that automatically sends a message to the closest cab.
GPS is used to constantly update the system on cab location so it can find the nearest vehicle to the caller.
GPS-based AVL systems also improve scheduling and management of bus fleets, subways, monorails and other public transportation systems. In some cities, GPS is used to map and manage school bus routes for more efficient and safer student transportation.

• In-vehicle navigation and telematics
GPS-based systems integrated with computer technology provide drivers with traffic, weather and location information, including "You Are Here" mapping displays. In Japan, drivers use these systems to avoid or compensate for traffic jams and delays.

• Accident location studies
Some police departments are using a pen-based computer system to collect data on accidents. The system uses data provided by GPS units in police cruisers to accurately record the date, time and location of an accident and link that information to Emergency Medical Service (EMS) records. GPS mapped data is used to study high accident areas and develop potential solutions to improve highway safety.

• Highway construction
GPS is used in all phases of highway construction. Survey data is used to design construction projects. Real-time GPS data is used to provide precision guidance and monitoring to heavy machinery during construction.

• Monitoring status of bridges
High accuracy GPS survey receivers are installed at critical locations on bridges to measure deflection and deformation. This data is used to engineer reinforcements to ensure bridge integrity and safety.

• Railroad fleet monitoring
Positive train control is being implemented in the United States through the deployment of a nation-wide differential GPS network based on vacated Air Force emergency communication sites.

• Train control and collision avoidance
A GPS-based separation system is being developed that will help trains avoid collisions. Using GPS information, the fully automated separation system will activate a warning aboard trains that are about to get too close to one another.

Potential Civil, Commercial and Consumer use for GPS in ground transportation

HEALTH CARE

• Tracking disease spread/distribution

• Immediate position/location of medical personnel and specialists

• Insect infestation mapping
The University of New Mexico mapped insect infestations in 11 Western states. The data yielded patterns that enabled disruption of insect life cycle, saving crops and reducing the use of insecticides.

• Epidemiological mapping
In sub-Saharan Africa, malaria causes the deaths of more than 1.5 million children annually. In a 1995 study, the Center for Disease Control (CDC) in Kenya used GPS to create a GIS of households, mosquito breeding sites, local health clinics, and permanent and seasonal rivers. Entomology and childhood mortality databases are linked to the GIS so that researchers can study the relationships between disease data and geographic factors.

• Personal navigation for blind persons
A system that uses synthetic speech connected to GPS location data is being developed at University of California, Santa Barbara. This audio system will actually 'tell' sight impaired individuals where they are and will use volume to indicate proximity to a landmark.

• Transportation of physically handicapped individuals
San Francisco-based Open Hand uses a GPS-based AVL system to schedule and track its fleet of vans.

• Tracking of Alzheimer and other patients
A Florida-based company has developed a GPS personal tracking system that tracks the whereabouts of the individuals wearing the device. This system is being used in a multitude of applications, including the tracking of Alzheimer's patients.

Potential Civil, Commercial and Consumer use for GPS in health care.

LAW ENFORCEMENT AND SAFETY

• Dispatch of ambulance, police and fire department personnel and equipment
GPS-based AVL systems are used to improve the responsiveness and efficiency of emergency services. These systems save lives by shaving minutes off the time between a call and the arrival of an emergency team at an accident or incident site. GPS navigation reduces the occurrence of EMS vehicles becoming lost en-route to difficult addresses.

• Search and rescue operations
GPS-aided accuracy improvements enables greater resource concentration on the rescue itself. In Iceland, GPS-equipped snowmobiles are used in search and rescue operations. GPS allows emergency personnel to conduct rescues in bad weather and precisely guide medical care to victim locations.

• Locating contraband or illegal substances
Law enforcement agencies use GPS to track and locate narcotics operations. GPS is used to mark the locations of isolated marijuana fields from the air. Then agents can find the locations on the ground using the GPS coordinates.

• Tracking/recovery of stolen vehicles
GPS is used to help police find stolen and hijacked cars and vehicles.

• Locating disabled vehicles for road services
GPS-tagged cellular phone calls help towing services find disabled vehicles.

• Search and rescue
GPS positioning data is combined with virtual reality software to build three-dimensional models of search areas to assist rescue personnel in finding lost vehicles and aircraft. The California Rescue Dog Association used GPS to determine exactly where dogs have searched to identify areas that were not sufficiently covered.

• Bomb sniffing
Researchers in Washington, D.C., are developing sensor devices which, coupled with GPS equipment helps detect unexploded ordinance on military installations and remediation sites around the world.

• Enhanced 911 (E-911) services
Enhanced 911 provides information on caller locations by querying a telephone company database of addresses matched to phone numbers. In Oregon, GPS was used to build highly accurate databases of mapped addresses that provide the foundation of the state's E-911 system.

• Security of high government officials and dignitaries while traveling
In high-risk countries GPS is used to provide security and safety for senior government officials. Similarly, GPS is used to track VIPs at large events, such as the World Cup championship games.

• Border surveillance.

• Emergency evacuation planning.

• Natural disaster damage assessment
GPS systems help map and assess the aftermath of natural disasters, including floods, earthquakes and fires. GPS is particularly useful when recognizable landmarks have been destroyed.

• Volcanic eruption monitoring and prediction
In Italy, the active volcano at Mt. Etna is monitored using GPS. Deformation of the cone indicates rising magma and imminent eruption.

• Earthquake monitoring and prediction
High-accuracy GPS surveying receivers are being used to monitor the earth's crustal movements preceding earthquakes. In Japan, a network of hundreds of GPS stations is monitoring shifts of a few millimeters in fault lines. In the United States, GPS systems gather data for geology research projects related to land mass movement.

• Serial criminals apprehended using GPS
Police have used GPS to track the attacks of serial rapists, muggers, and robbers, leading to arrests by predicting the time and location of the next attack.

• Parolee monitoring and tracking
In Florida, law enforcement agencies are using a GPS-based system worn by parolees to track them. The system ensures that parolees do not violate their parole, and keeps constant track of their location in real-time.

Potential Civil, Commercial and Consumer use for GPS in law enforcement and safety

MARITIME AND WATERWAYS

• Emergency distress signals on the high seas
GPS and satellite communications systems are now required by the International Maritime Organization (IMO). By February of 1999, 40,000 ships will be required to carry a GPS-based system that can send out emergency distress signals that include location and time data.

• GPS and INMARSAT
Merging GPS and INMARSAT technologies has provided vessel operators and their land-based offices with a full range of services, such as exact position data, two-way messaging, maritime safety information and emergency notification.

• Mapping underwater obstacles during hydrographic surveys
The HMNZ Ship Monowai used GPS to re-survey parts of the New Zealand coast to update navigational charts initially produced by the Royal Navy in the 19th century. GPS coastal and harbor surveys provided better than three-meter accuracies, and deep-water surveys were accurate to approximately 15 meters.

• Search and rescue
Within hours of the crash of TWA Flight 800, dozens of watercraft were on the site to provide search and rescue services. A NOAA vessel equipped with precision GPS technology was used to map the site and recover evidence. Rescue personnel use GPS help track search patterns to find drowning victims lost in rivers, lakes and oceans around the world.

• All weather harbor navigation approach
The U.S. Coast Guard and countries all over the world use GPS to provide navigation data for coastline and harbor navigation, as well as to position navaids and buoys on the coast and inland waterways.

• Vessel traffic services

• Precise navigation of inland waterways

• Harbor facility management
In Dubai (United Arab Emirates), GPS-based systems are used to schedule delivery and loading of containers at one of the busiest ports in the world. In Los Angeles, American Presidents Line is managing a brand new facility using a high-tech system that includes GPS-based container tracking.

• Locations of shipping containers and auto-piloted barges
GPS-based systems keep track of containers and auto-piloted barges to ensure cargo safety.

• Enhanced Loran-C marine navigation

• Dredging of harbors and waterways
GPS is being used in a dredging operation on the Panama Canal and at hundreds of other locations around the world.

• Offshore drilling research and exploration

• Ship trials and testing

• Monitoring icebergs and rouge flows

• Precision ice breaking operations

• Observing tides and currents

• Location of commercial fishing traps and nets
GPS is used to map and navigate to oyster beds. Commercial fishing operations also use GPS to mark the location of productive fishing sites.

• Enforcement of international fishing rights
GPS data has been introduced in international courts to resolve disputed fishing claims. Boats caught poaching can also be required to install GPS-based tracking systems so they can continue to be tracked after they pay their fine.

Potential Civil, Commercial and Consumer use for GPS for maritime and waterways

MINING AND CONSTRUCTION

• Electronic marking of geological sites and events

• Accurate stockpile record keeping
Accurate, repeated GPS surveys of ore and coal stockpiles permit frequent volume calculations and greatly improved stockpile management.

• Precision location for mine surveying
In Indonesia, GPS is used for better scheduling and achieving better throughput at the terminal of un-manned coal barges from several remote areas. Scheduling is complicated by a variety of factors, such as different barge sizes, unloading into an area for the correct grade of coal, various barge journey times, varying loading times at the mines and terminal, and railroad scheduling at the terminal.

• Bridge and other marine construction operations
In Korea, GPS-based technology was used to install with centimeter precision the pre-built center-arched 150-meter span of the Seo-Kang Grand Bridge. An earlier span, incorrectly positioned, had failed and fallen into the river.

• Cost-cutting and increased productivity in open cut mines
Real-time surveys in Queensland, Australia are used for local planning and control, topographic and detail work in open cut mines. Machine guidance is the next step in GPS for mining, road construction, rough grading, landfill, trash and solid waste management, and other uses.

• Precision location for mining explosives
GPS-guided drilling machines follow CAD-generated plans for blast hole location. Higher precision results in more predictable blast patterns and improved productivity by blasting crews.

Potential Civil, Commercial and Consumer use for GPS in mining and construction

RECREATION/ARTS/ENTERTAINMENT

• Recreational boating and sport fishing
GPS allows boaters to know their precise position to avoid running aground, making sailing and boating safer. Allows mariners to navigate 24 hours a day in any kind of weather, including heavy fog.

• Tracking and monitoring of golfers and golf carts
ProShot Golf has developed a system that tracks golf carts and players, allowing golf courses to run more efficiently through better scheduling of tee off times and better monitoring of player locations on the course. GPS also informs golfers of the accurate distance to the cup, enabling them to better choose the correct club.

• Special effects and sound timing for film and video production
GPS is increasingly being used in filming special effects. During the production of the feature film "Daylight," GPS timing was used to mark actual footage so that special effects could be added at the right place in the film.

• GPS transfers reality into virtual reality
A San Francisco audience flew through an accurate virtual depiction of the City's terrain, including a trip across the Golden Gate Bridge in a virtual world created from GPS positioning data.

• Auto and bike race course planning
GPS is used to give some competitors an edge in pre-race planning by modeling the entire racing course.

• Navigation and safety for hikers, bikers and trekers
GPS has been used to guide many cross-continent and exploratory biking expeditions.

• Precision measurements and mapping for landscape architecture
Landscape architects use GPS to map land for planning and design of landscape architecture projects. GPS provides an inexpensive tool that produces much faster, more accurate results than hand mapping.

INFRASTRUCTURE DEVELOPMENT/ MANAGEMENT

• Lower-cost, faster infrastructure development in underdeveloped countries
Using GPS, surveyors are able to quickly and accurately map large uncharted landmasses and sea beds for natural resource harvesting, transportation infrastructure development and economically significant products.

• Development of geodetic survey networks
Engineers and surveyors in Russia, China, Puerto Rico, Brazil and Guam use GPS to build accurate survey networks to support development.

• Project to restore eroded beachfront
Surveys were launched by Auckland City Council in New Zealand to establish existing beach levels and to ensure correct sand replacement.

• Reducing costs on expensive ground surveys in swamps, marshes and rainforests
An oil and gas survey was conducted in Equatorial West Africa with greater accuracy using GPS.

• Oil pipeline development and monitoring
GPS was used during a to lay a 333 km pipeline in the Gulf of Thailand.

• Fiber optic cable communications
GPS positioning and navigation are used to lay fiber optic cables over thousands of miles of ocean and across undersea mountains and plains.

• Utility GIS development for strategic capital asset management
Utilities use GPS to map and manage geographically distributed capital assets. This information allows utilities to be more responsive when problems occur because the utility infrastructure is accurately mapped, and all assets are located and identified. A North Carolina utility outfitted mountain bikes with GPS mapping systems to approach and register 80,000 telephone poles and 60,000 other service features in their territory.

• GPS savings for the cable TV industry
Precise distance measurements via GPS reduce the time required to gather data for installing cable TV services.

• Development of county- and city-side GIS databases
In Dallas, TX, a city-wide GIS that includes boundary, infrastructure and demographic data is shared among 14 organizations. Using a single coordinate system for development and planning greatly lowers the cost of these activities. Re-searchers in New Mexico are using a GPS-based mapping system to map pueblos. Properties and facilities are mapped in an effort to improve not only tribal lands, but to improve service by law enforcement, fire, and rescue personnel.

• National Spatial Data Infrastructure
The United States is developing a common national reference system to support the many use of geospatial data by public and private agencies. GPS-based coordinate measures are a critical enabling technology for this effort.

WEATHER FORECASTING

• Measuring water vapor for weather forecasting and climate research
NOAA successfully investigated the use of measuring atmospheric water using GPS data as a reliable, continuous and low-cost measurement under any weather conditions. In this application, the highly accurate location information is disregarded. Instead, scientists study the time delay of GPS signals as they travel through the atmosphere to estimate water vapor conditions.

PUBLIC SAFETY

• The Riverside Flood Control District uses GPS to help plan, design, and maintain flood control and drainage facilities.

• The Metropolitan Water district of So. California uses GPS to monitor the new Domenigoni Valley Reservoir Project, the largest earthen dam in the world.

• Lifeguard Systems Inc. uses GPS to help track search patterns to find drowning victims lost in rivers, lakes and oceans around the world.

•Landform Inc. combines GPS information with virtual reality software to build three-dimensional models of search areas to assist rescue personnel in finding lost vehicles and aircraft.

ATTACHMENT B

Spectrum Usage Report, Frequency Band: 216-2220 MHz

Comsearch
February 23, 2001

COMSEARCH

Spectrum Usage Report

Frequency Band: 216-220 MHz

Report Prepared for Telecomm Strategies
by
Comsearch

February 23, 2001

Contact: Joanna F. Nickerson
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I. General Overview of Band Usage

216 – 220 MHz: Government and Non-Government Shared Band

A. Both Government and Non-Government Usage

Type of Services: **Maritime Mobile Service (MMS) – Primary Basis**

Land Mobile Service – Secondary Basis

Fixed – Secondary Basis

Aeronautical Mobile Service (AMS) – Secondary Basis

Low Power Radio Service (LPRS) - Secondary Basis

B. Government Usage Only

Type of Service: Radiolocation – Secondary Basis

Though allocated secondary, there continue to be critical Federal radiolocation requirements in this band. The U.S. Navy operates the SPASUR system in the band 216.88-217.08 MHZ at several locations in the southern U.S. for the purpose of detecting Earth orbiting satellites. Assignments to the fixed and mobile service may be made on condition of no harmful interference to the SPASUR system.

II. Detailed Service Description and Interference Issues

PRIMARY SERVICES

216 – 218 MHz &
219 – 220 MHz: Automated Maritime Telecommunication System (AMTS) – Primary Basis

Description of Service

The maritime mobile service (MMS) is an internationally allocated radio service providing for safety of life and property at sea and on inland waterways. The Automated Maritime Telecommunications System (AMTS) service is used on inland waterways, such as the Great Lakes, Ohio River, Mississippi River, and Gulf Coast for ship-to-shore voice and data communications.

Land stations in the marine services are the links between vessels at sea and activities ashore. They are spread throughout the coastal and inland areas of the United States to carry radio signals and messages to and from ships on the water. AMTS stations are a special type of public coast station operating in the 216-220 MHz band. AMTS

stations are licensed to provide coverage over an entire inland waterway or a substantial portion of an ocean coastline.

License Area and Geographic Distribution

AMTS licensees are issued blanket authority for a system of coast stations and mobile units (subscribers). AMTS applicants have to specify the maximum number of mobile units to be placed in operation during the license period. [CFR 47, Section 80.45].

Important Documents on the AMTS Service and Interference Issues

CFR Volume 47, Part 80.

Section 80.475 Scope of service of the Automated Maritime Telecommunications System (AMTS).

(a) AMTS applicants proposing to serve inland waterways must show how the proposed system will provide continuity of service along more than 60% of each of one or more navigable inland waterways. Inland waterways less than 240 kilometers (150 miles) long must be served in their entirety. AMTS applicants proposing to serve portions of the Atlantic, Pacific or Gulf of Mexico coastline must define a substantial navigational area and show how the proposed system will provide continuity of service for it. A separate Form 503 is not required for each coast station in a system. However, the applicant must provide the technical characteristics for each proposed coast station, including transmitter type, operating frequencies, emissions, transmitter output power, antenna arrangement and location.

(1) Applicants proposing to locate a coast station transmitter within 169 kilometers (105 miles) of a channel 13 television station or within 129 kilometers (80 miles) of a channel 10 television station or with an antenna height greater than 61 meters (200 feet) must submit an engineering study clearly showing the means of avoiding interference with television reception within the grade B contour.

(2) Additionally, applicants required to submit the above specified must give written notice of the filing of such application(s) to the television stations which may be affected. A list of the notified television stations must be submitted with the subject applications.

(b) In lieu of public correspondence service an AMTS system may provide private coast station communications related to the operational requirements of ships including transmissions of fuel, weather, position and supply reports. However, such communications may be provided only to ship stations whose licensees make cooperative arrangements with the AMTS coast station licensees. In emergency and distress situations, services must be provided without prior arrangements.

[51 FR 31213, Sept. 2, 1986, as amended at 52 FR 35245, Sept. 18, 1987; 56 FR 3783, Jan. 31, 1991]

Section 80.477 AMTS points of communication.

(a) AMTS coast stations may communicate with fixed platform stations located in the offshore waters of the Gulf of Mexico, with ship stations, and with land units in accordance with Sec. 80.123.
(b) AMTS licensees in the offshore waters of the Gulf of Mexico may use AMTS coast and ship station frequencies on a secondary basis for fixed service communications to support offshore AMTS operations.
(c) AMTS service may be provided to any vessel within communication service range of an AMTS station even though the vessel may not be operating within the confines of a served waterway.
[51 FR 31213, Sept. 2, 1986, as amended at 52 FR 35245, Sept. 18, 1987; 62 FR 40307, July 28, 1997]

Subpart H, Section 80.385 Assignment and use of frequencies for AMTS.

218 – 219 MHz: Interactive Video and Data Services (IVDS) – Primary Basis

Important Documents on the 218-219 MHz Service

218-219 MHz Service rules are contained in 47 C.F.R. Part 95, Subpart F (Sections 801-863)

Amendment of Part 95 of the Commission's Rules to Provide Regulatory Flexibility in the 218-219 MHz Service

Report and Order and Memorandum Opinion and Order
WT Docket No. 98-169
17 Comm.Reg. (P&F) 222, 1999
Released September 10, 1999
FCC News Release, September 7, 1999
Final Rule: 64 FR 59265, November 3, 1999

Order on Reconsideration
WT Docket No. 98-169
Released November 30, 1999
Final Rule: 64 FR 72956, December 29, 1999

Notice of Proposed Rulemaking
63 FR 52215, September 30, 1998

Description of Service

The 218-219 MHz IVDS band is used for point-to-multipoint, multipoint-to-point short distance communications. Mobile operations are permitted. It was originally designed for licensees to transmit information, product and service offerings to its subscribers and receive interactive responses. This includes such applications as ordering goods and services offered by television services, viewer polling, remote meter reading, vending inventory control, and cable television theft deterrence. The 218-219 MHz Service rules were revised in 1999 to permit both common carrier and private operations, as well as one- and two-way communications.

The 218-219 MHz band is insufficient for the transmission of conventional full-motion video. Although the new rules are designed to allow licensees the maximum flexibility to structure services to meet market demand, 218-219 MHz Service channels may be unable to support proposed operations that require large amounts of spectrum, including certain video, voice and advanced data applications.

License Area and Geographic Distribution

The IVDS service is currently licensed in 734 service areas including 306 Metropolitan Statistical Areas (MSAs) and 428 Rural Service Areas (RSAs). Each service area is allocated two channels: Channel A (218.0-218.5 MHz) and Channel B (218.5-219.0 MHz).

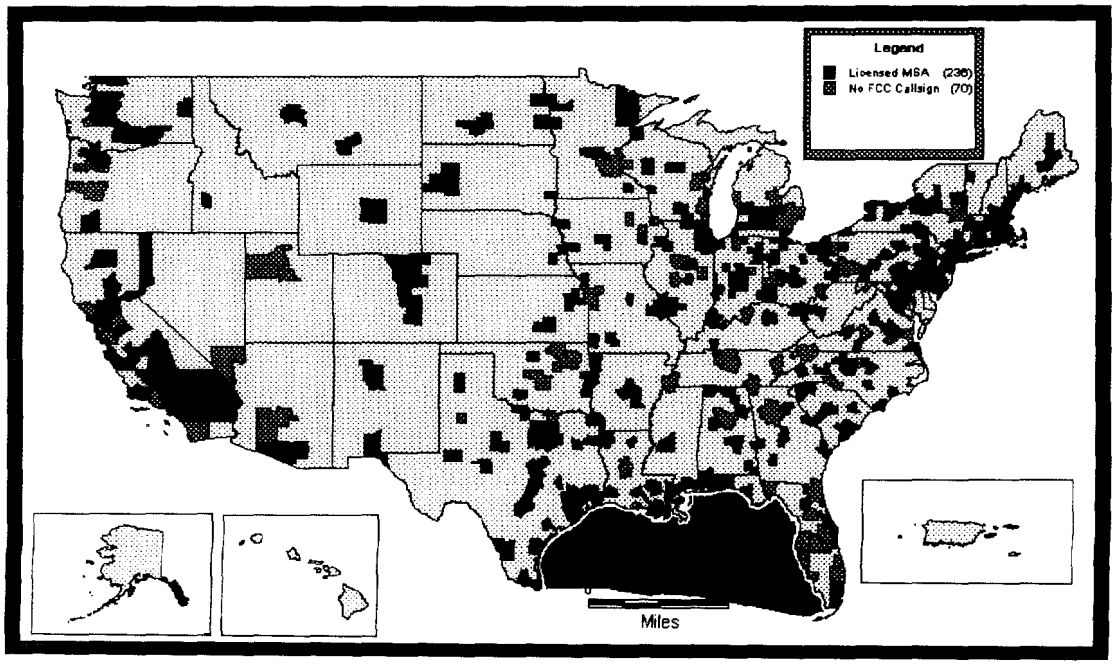
On September 15, 1993, the Commission held a lottery to determine license winners from among those who filed mutually exclusive applications in 9 IVDS markets (total of 18 licenses). On July 28 and 29, 1994, the Commission conducted an oral outcry auction for the remaining MSA licenses that were not issued by lottery. Of the 306 MSAs in the US, 297 were auctioned off (total of 594 licenses). No RSA licenses have been issued to date.

178 different bidders won licenses in the 1994 auction. The top ten bidders by number of licenses won are listed below.

Winning Bidder	Number of Licenses Won
COMMERCIAL REALTY ST PETE. INC	20
LOLI INC	18
VITECH CORPORATION	18
EAGLE INTERACTIVE PARTNERS LP	15
INTERACTIVE AMERICA CORPORATION	15
TWO WAY TV INC	13
ELLERON TELECOMMUNICATIONS CORP	12
MEDIA VENTURES	12
FRIENDS OF IVDS	11
BALLPARK SOUVENIRS INC	10
SKYTOUCH COMMUNICATIONS INC	10

A detailed chart of all the IVDS licensees is included with this report in Appendix A. If the licensee has been authorized for service in the licensed area, a callsign has been assigned. If there is no callsign, then application requirements have not been met. A plot of all active IVDS licenses appears below.

IVDS Licensees
218 219 MHz



Under the revised service rules, all licenses are issued for a ten-year term, and licensees must meet a "substantial service" construction requirement upon renewal. Ownership of both the "A" and "B" channel blocks in the same market is now permitted. Because the Report and Order changed the license term to ten years from five years, current 218-219 MHz Service licenses do not expire until 2004 and 2005. No renewals are necessary at this time, and the Commission is not currently accepting renewal applications for the 218-219 MHz Service.

Interference Issues

Part 95.861 contains the FCC rules on interference for IVDS.

"(a) When an IVDS system suffers harmful interference within its service area from or causes harmful interference to another IVDS system, the licensees of both systems must cooperate and resolve the problem by mutually satisfactory arrangements. If the licensees are unable to do so, the Commission may impose restrictions including, but not limited to, specifying the transmitter power, antenna height, or area or hours of operation of the stations concerned.
(b) The use of any frequency segment at a given geographical location may be denied when, in the judgment of the Commission, its use in that location is not in the public interest; the use of a frequency segment specified for the IVDS system may be restricted as to specified geographical areas, maximum power, or other operating conditions.
(c) Unless the IVDS system licensee obtains written consent from the TV Channel 13 station licensee to dispense with this notification, each IVDS system licensee must notify all households located both within a TV Channel 13 station Grade B predicted contour and the IVDS system service area of the potential for interference from an IVDS system. The IVDS system licensee must also inform those potentially affected households that it will eliminate any objectionable interference to television reception caused by its IVDS system. This notification shall be made no earlier than two weeks before and no later than two weeks after initiation of IVDS in the TV Channel 13 station Grade B predicted contour. The written consent must be kept as part of the IVDS system authorization.
(d) Each IVDS system licensee must provide upon request, and install free of charge, an interference reduction device to any household within a TV Channel 13 station Grade B predicted contour that experiences interference due to a component CTS or RTU.
(e) Each IVDS system licensee must investigate and eliminate interference to television broadcasting and reception, from its component cell transmitter stations (CTSs) and response transmitter units (RTUs), within 30 days of the time it is notified in writing, by either an affected television station, an affected viewer, or the Commission, of an interference complaint. Should the licensee fail to